

POSSIBLE POSTCOPULATORY MATE GUARDING
IN *ORNITHOPTERA EUPHORION* (GRAY)
(LEPIDOPTERA: PAPILIONIDAE)

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Abstract

Observations were made on the courtship behaviour of *Ornithoptera euphorion* (Gray) at Bramston Beach, north Queensland. An instance is described of a male, known to have mated with a female, following her for about a day and driving off other males who courted her. Three other examples of apparent guarding involving pairs where mating was not observed are also noted.

Introduction

Following insemination, males of many butterfly species produce a mating plug, which seals the ostium bursae or copulatory opening and prevents or delays remating by the female (Ehrlich and Ehrlich 1978, Dickens and Rutowski 1989). Owing to the ditrysian arrangement of the female reproductive tracts found in all higher Lepidoptera, the plug does not impede oviposition and may remain in place for life. When freshly formed the plug is soft and gelatinous and over a period of one to two days it contracts and hardens (Orr 1988, Matsumoto and Suzuki 1992). It has been shown in *Atrophaneura alcinous* Klug that the freshly formed plug can be easily penetrated or pushed aside by the aedeagus of another male and that males sometimes cling to mating pairs and mate successfully with the female when the original pair separate (Suzuki and Matsumoto 1990, Matsumoto and Suzuki 1992). This behaviour sometimes also occurs in *Ornithoptera richmondia* (Gray) maintained in captivity (Orr, unpublished observations). It would seem logical therefore, that if males could successfully drive off potential mates in the period following mating while the plug remains soft, they would minimize the risks of the female remating with another male and using his sperm to fertilize her eggs.

The details of courtship behaviour in *Ornithoptera* Boisduval and *Troides* Hübner species have never been fully described and vary considerably with circumstances. However in all species of the two genera for which information is available, including *O. euphorion* (Gray), the male hovers briefly below the female, then flies directly in front of her, possibly brushing her antennae with the androconia which fringe the anal margin of the hindwings, then hovers about half a metre above her. Immediately before a mating or mating attempt, it is common for the male to splay his hindwings slightly and bring them together in an abrupt scissor action, which may serve to disseminate pheromones. Mating is attempted generally only when the female is quiescent, or at least has ceased to flap her wings. This cycle may be repeated many times. It may be performed on newly emerged females,

where mating follows very quickly, or on feeding females and flying females; in the latter case the male describes a series of progressive ellipses about the female as he follows her. Brief accounts of courtship in *T. oblongomaculatus papuensis* Wallace and in *O. richmondia* are given by Parsons (1983) and Orr (1988) respectively. Most of the courtships observed in nature probably involve already mated females and remating seldom results but, as in *O. richmondia* between 10-20% of old females contain more than one spermatophore, polyandry evidently does occur in nature and a small proportion of such courtships must be successful (Orr 1988, unpublished observations).

Methods

Between 8-15 February 1999 I spent a total of 14.5 hours observing the courtship and other sexual interactions of *O. euphorion* around cultivated *Hibiscus* flowers at Bramston Beach, near Innisfail, north Queensland. Owing to legal restrictions on handling this species I was unable to capture and mark individuals, but at least four males and three females were identifiable by the distinctive wing damage. Much wing chipping may have been caused by Yellow-bellied Sunbirds (*Nectarina jugularis*), which frequently pecked the butterflies, apparently in defence of their feeding territories. The butterflies were observed by using compact wide angled binoculars. Any distinguishing marks were noted and recorded. Notes of behaviour were made using a small hand held dictophone.

Results

Five interactions in which a male continually courted a female were followed for approximately half an hour to one hour, until either the pair was lost from sight or the male ceased courtship attempts. Although males often alighted beside or on top of the female and attempted mating, successful coupling was never achieved and, following such attempts, females invariably alighted and flew at least a few metres before resuming feeding, whereupon the male recommenced courtship. On two occasions the male grappled with the female and carried her to the ground but was unable to hold her in either case. In all cases the female was almost certainly mated and probably bore a mating plug, which would have been difficult to dislodge. After such aggressive mating attempts females normally departed. The frequency of mating attempts varied but typically took place every five to fifteen minutes over a period of up to an hour or more.

Such observations are typical of the courtship behaviour of males with mated females which is frequently observed. However on one occasion (12 Feb. 1999) I observed a mated pair arrive at the flowers at 0920h, where they commenced feeding. At 0935h they separated and as both bore distinctive damage I was able to recognize them on subsequent encounters and intermittently observe their behaviour throughout the day. Following

separation the pair remained at the flowers and continued feeding for another 63 minutes. The male remained close to the female and was rarely more than a metre from her. Five minutes after they separated a smaller male arrived at the nectar and, after feeding briefly, began to court the female. The original male tolerated his presence until he had been hovering above the female for about three minutes, when he flew at the intruder and chased him for about 50 metres, then returned to an inflorescence near the female. Over a period of 58 minutes the small male returned and courted the female persistently, only to be attacked and routed by the first male on five occasions. Two cues, which were correlated, seemed to trigger his aggression. He attacked either when the female ceased to flutter her wings while the second male was hovering above her, or when the second male splayed and then snapped his hindwings against his abdomen, a movement which normally indicates an intention to attempt mating. On two occasions the first male grappled with the second and carried him to the ground. At no time did the first male court the female for more than a few seconds and this was only immediately following a serious altercation with the interloper. At 1038h the female flew off, closely followed by the first male. I relocated the same pair later in the day at another clump of *Hibiscus* about a kilometer distant, with the male still in close attendance but not courting the female. On this occasion the pair were observed for 42 minutes, during which time the male drove off two other males, both quite distinct from the original interloper. The pair reappeared at the original location at 1515h. They fed undisturbed for 12 minutes when a small male, almost certainly the original interloper, arrived and after feeding at nectar for five minutes began again to court the female. Between 1520 and 1710h the pair continued to feed with the small male almost continually courting the female. He was driven off on six occasions by the first male. The final interaction, at 1708h, was particularly dramatic. Following a prolonged period of courtship, the interloper dived on the female and carried her to the ground. The first male swooped onto the struggling pair and seized the male, whereupon the female was freed and flew away. After the males had grappled on the ground for about 30 seconds the second male escaped and flew away rapidly, with the first in pursuit. I did not see them again that day. Also during this period (i.e. 1520-1710h) two other males arrived and courted the female, sometimes at the same time as the small male, but these were eventually driven off by the original male or lost interest following a series of altercations with the small male.

The following morning at the original site I saw the female again between 0820 and 0930h, this time unaccompanied by the first male, who I observed nectaring at the same site later in the day, between 1310 and 1320h, and again between 1600 and 1630h. On that day, between 1510 and 1640h, I also observed another pair, which although not observed in copula, exhibited similar apparent guarding behaviour to that described above. This male bore no distinguishing marks but he was seen constantly defending the female

from several interlopers, including the male from the previous pair, and particularly the small original interloper described above who he attacked and chased on seven occasions, three times seizing him and taking him to the ground. The female was recognizable and was observed two days later without an escort.

Prior to these observations (8-9 Feb. 1999), I twice observed between 1600 and 1800h a similar series of interactions between a guarding male which fed and did not attempt courtship, a feeding female, and one or more courting males which seldom fed. Other unguarded females also visited the flowers and were subjected to courtship without result, but these usually did not remain at the site for more than half an hour. In the light of the above observations it seems reasonable to suggest that in these cases too the guarding male had mated with the (guarded) female that day, and both were replenishing their energy reserves.

Discussion

While these results do not provide a statistical sample they are sufficiently unique to merit recording. Non-contact mate guarding is widespread in some insects, especially the Odonata (Corbet 1961), but has never been reported in the Lepidoptera. Following mating, females of most species are unresponsive to male courtship for several days, even in polyandrous species (Obara *et al.* 1975, Suzuki *et al.* 1977) and hence a mating plug, if present, is likely to have hardened and be effective by the time the female accepts another mating. Mate guarding would be most expected in species in which forced copulation without courtship occurs. This happens only in sphragis bearing species such as *Cressida cressida* Fabricius and *Acraea andromacha* Fabricius (Orr 1988, 1995, 1999) and a few highly polyandrous species in which males secure many matings and do not produce a mating plug, such as *Danaus plexippus* Linnaeus (occasionally, Pliske 1975) or *Acraea natalica* Boisduval (Orr 1988). In *C. cressida* the female is not normally released until the sphragis is completely hardened (Orr and Rutowski 1992, Orr 1999), a situation analogous to contact mate guarding in the Odonata, and in *A. andromacha* females are usually intercepted at hilltops and at the site of the larval foodplant, rather than at nectar sources which are mostly dispersed; hence freshly mated females are less likely to be molested although this has been recorded (Epstein 1987). Males of polyandrous species which produce no mating plug would be expected to direct their efforts to seeking more mates, rather than attempting to guard one who may be almost guaranteed to remate eventually.

Observations of caged *O. richmondia* suggest that females will accept matings while the plug is still soft, especially if the first male has donated a small spermatophore and the second male is especially persistent. Forced copulation such as occurs in *C. cressida* is probably physically impossible as

the male must force the female to evert her sinus vaginalis, which would be a difficult if not impossible operation if the female did not acquiesce to some extent; but it is possible that a female might accept a mating soon after the first if only to escape the attentions of an especially persistent male. I have not previously witnessed the probable guarding behaviour described above, in either *O. richmondia* or *O. euphorion*, perhaps partly because I have seldom seen such a concentration of *Ornithoptera* in such easy terrain, but it is also possible that the male guarding behaviour occurs only facultatively when population densities are high and females are likely to be subjected to intense courtship from other males immediately after mating.

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References

- CORBET, P.S. 1961. *The biology of dragonflies*. Witherby, London.
- DICKINSON, J.L. and RUTOWSKI, R.L. 1989. The function of the mating plug in the chalcid checkerspot butterfly. *Animal Behaviour* 38: 154-162.
- EHRlich, A.H. and EHRlich, P.H. 1978. Reproductive strategies in the butterflies: I. Mating frequency, plugging and egg number. *Journal of the Kansas Entomological Society* 51: 666-697.
- EPSTEIN, M. 1987. Mating behaviour of *Acraea andromacha andromacha* (Fabricius) in New Caledonia. *Journal of the Lepidopterists' Society* 41: 119-121.
- MATSUMOTO, K. and SUZUKI, N. 1992. Effectiveness of the mating plug in *Atrophaneura alcinous* (Lepidoptera: Papilionidae). *Behavioral Ecology and Sociobiology* 30: 157-163.
- OBARA, Y., TATEDA, H. and KURABARA, M. 1975. Mating behaviour of the cabbage butterfly, *Pieris rapae crucivora* Boisduval. V. Copulatory stimuli inducing changes in female response patterns. *Dobut Zasshi* 84: 71-76.
- ORR, A.G. 1988. *Mate conflict and the evolution of the sphragis in butterflies*. Unpublished PhD thesis, Griffith University, Nathan; 348 pp.
- ORR, A.G. 1995. The evolution of the sphragis in the Papilionidae and other butterflies. Chapter 16, in: Scriber, J.M., Tsubaki, Y. and Lederhouse, R.C. (eds), *Swallowtail butterflies: their ecology and evolutionary biology*. Scientific Publishers, Gainesville; pp 155-164.
- ORR, A.G. 1999. Biology of *Cressida cressida* (Fabricius) (Papilionidae: Troidini). In: Kitching, R.L., Scheermeyer, E., Jones, R.E. and Pierce, N.E. (eds). *Biology of Australian butterflies*. Monographs on Australian Lepidoptera 6. CSIRO Publications, Melbourne.
- ORR, A.G. and RUTOWSKI, R.L. 1991. Mating plug carried by female signals mated status to male in the Big Greasy, *Cressida cressida* (Lepidoptera: Papilionidae). *Journal of Natural History* 25: 703-710.
- PARSONS, M.J. 1983. Notes on the courtship of *Troides oblongomaculatus papuensis* (Papilionidae) in Papua New Guinea. *Journal of the Lepidopterists' Society* 37: 83-85.
- PLISKE, T.E. 1975. Courtship behaviour of the monarch butterfly *Danaus plexippus* L.. *Annals of the Entomological Society of America* 68: 143-151.

- SUZUKI, N. and MATSUMOTO, K. 1990. Pair clinging behaviour of *Atrophaneura alcinous* (Lepidoptera: Papilionidae). *Journal of Ethology* 8: 45-51.
- SUZUKI, Y., NAKANISHI, A., SHIMA, H., YATA, O. and SAIGUSA, T. 1977. Mating behaviour of four Japanese species of the genus *Pieris* (Lepidoptera, Pieridae). *Kontyu* 45: 300-313.

CORRIGENDA

In Figure 1 of Orr and Kitching (1999), captions (i) and (j) are transposed. Fig. (i) is *Beara falcata*; fig. (j) is *Scaphidriotis* sp.

ORR, A.G. and KITCHING, R.L. 1999. A checklist of macrolepidoptera collected from rainforest and former forest areas on basalt soils on the Atherton Tableland. *Australian Entomologist* 26(1): 15-27.